

Reinventing the Soft X-ray Spectroscopy of Actinides

A major breakthrough in the soft X-ray spectroscopy of the highly radioactive actinides has been achieved with a new, unique spectrometer at Lawrence Livermore National Laboratory [Rev. Sci. Instrum. 82, 093903 (2011)]. A recently published article in *Phys. Rev. Lett.* [1] documents the culmination of a series of experiments using Resonant Inverse Photoelectron Spectroscopy (RIPES) and X-ray Emission Spectroscopy (XES) of Cerium Oxide [Phys. Rev. B 83, 085104 (2011)], X-ray Absorption Spectroscopy of Uranium Dioxide (UO₂) [Phys. Rev. B 83, 165102 (2011)], and the X-ray Photoelectron Spectroscopy of UO₂ [J. Vac. Sci. Tech. A 29, 021008 (2011)]. This publication [1] demonstrates that we can directly determine and separate the 5f and 6d unoccupied states of an actinide without the need for synchrotron-radiation sources. While unencapsulated samples of low activity materials such as UO₂ can be taken to scientific national user facilities, highly radioactive systems such as plutonium (Pu) cannot and will be the focus of the next set of RIPES experiments. The ultimate goal of this research is to apply this novel approach to Pu, where the nature of its electronic structure and the underlying electron correlation remain unknown and a longstanding enigma in condensed matter physics.

[1] J. G. Tobin and S. W. Yu, "Orbital Specificity in the Unoccupied States of UO₂ from Resonant Inverse Photoelectron Spectroscopy," *Phys. Rev. Lett.* 107, 167406 (2011)

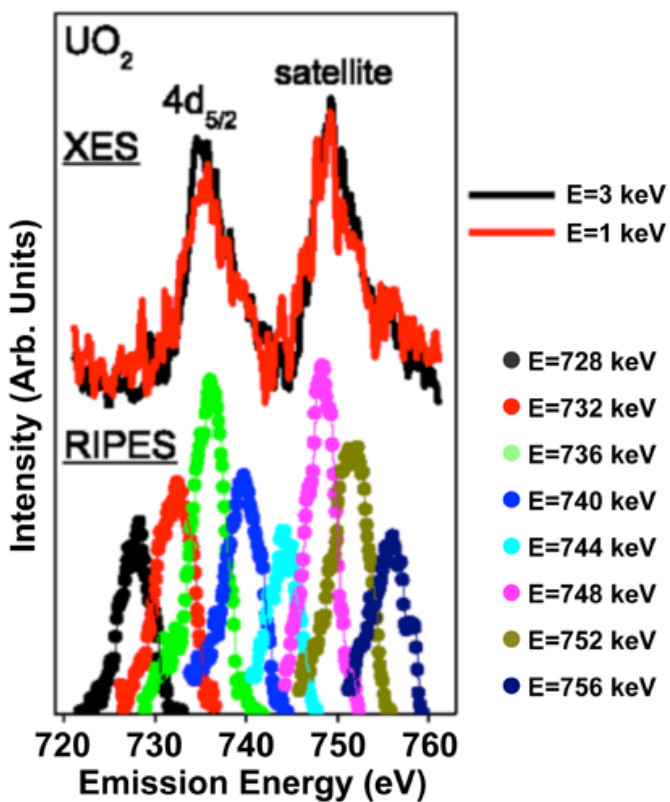


Figure Caption

RIPES and XES spectra of Uranium Dioxide. The XES is shown in the upper part of the figure and the RIPES in the lower part of the figure. The main peak is due to the 5f states and the satellite is due to the 6f states, thus allowing their separation.